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PROVISIONAL APPLICATION COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION under 37 C.F.R. 1.53 (c).

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TITLE OF THE INVENTION (280 characters max)
MOLDED WOOD FLAKE ARTICLE WITH INTEGRAL FLEXIBLE SPRING MEMBER

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The Invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

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Respectfully submitted,

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☐ Additional inventors are being named on separately numbered sheets attached hereto.

PROVISIONAL APPLICATION FILING ONLY

MOLDED WOOD FLAKE ARTICLE WITH INTEGRAL FLEXIBLE SPRING MEMBER

BACKGROUND OF THE INVENTION

Wood flake molding, also referred to as wood strand molding, is a technique invented by wood scientists at Michigan Technological University during the latter part of the 1970s for molding three-dimensionally configured objects out of binder coated wood flakes having an average length from about 1 ¼ to about 6 inches, preferably from about 2 to about 3 inches; an average thickness of about 0.005 to about 0.075 inches, preferably from about 0.015 to about 0.030 inches; and an average width of 3 inches or less, most typically 0.25 to 1.0 inches, and never greater than the average length of the flakes. These flakes are sometimes referred to in the art as "wood strands." This technology is not to be confused with oriented strand board technology (see e.g., U.S. Patent No. 3,164,511 to Elmendorf) wherein binder coated flakes or strands of wood are pressed into planar objects. In wood flake or wood strand molding, the flakes are molded into three-dimensional, i.e., non-planar, configurations.

In wood flake molding, flakes of wood having the dimensions outlined above are coated with methylene diisocyanate (MDI) or similar binder and deposited onto a metal tray having one open side, in a loosely felted mat, to a thickness eight or nine times the desired thickness of the final part. The loosely felted mat is then covered with another metal tray, and the covered metal tray is used to carry the mat to a mold. (The terms "mold" and "die", as well as "mold die", are sometimes used interchangeably herein,

reflecting the fact that "dies" are usually associated with stamping, and "molds" are associated with plastic molding, and molding of wood strands does not fit into either category.) The top metal tray is removed, and the bottom metal tray is then slid out from underneath the mat, to leave the loosely felted mat in position on the bottom half of the mold. The top half of the mold is then used to press the mat into the bottom half of the mold at a pressure of approximately 600 psi, and at an elevated temperature, to "set" (polymerize) the MDI binder and to compress and adhere the compressed wood flakes into a final three-dimensional molded part. The excess perimeter of the loosely felted mat, that is, the portion extending beyond the mold cavity perimeter, is pinched off where the part defining the perimeter of the upper mold engages the part defining the perimeter of the lower mold cavity. This is sometimes referred to as a pinch trim edge.

U.S. Patents 4,440,708 and 4,469,216 disclose this technology. The drawings in Patent U.S. 4,469,216 best illustrate the manner in which the wood flakes are deposited to form a loosely felted mat, though the metal trays are not shown. By loosely felted, it is meant that the wood flakes are simply lying one on top of the other in overlapping and interleaving fashion, without being bound together in any way. The binder coating is quite dry to the touch, such that there is no stickiness or adherence which hold them together in the loosely felted mat. The drawings of Patent U.S. 4,440,708 best illustrate the manner in which a loosely felted mat is compressed by the mold halves into a three-dimensionally configured article (see Figs. 2-6, for example).

The above described process is a different molding process as compared to a molding process one typically thinks of, in which some type of molten, semi-molten or other liquid material flows into and around mold parts. Wood flakes are not molten, are not contained in any type of molten or liquid carrier, and do not "flow" in any ordinary

sense of the word. Hence, those of ordinary skill in the art do not equate wood flake or wood strand molding with conventional molding techniques.

SUMMARY OF THE INVENTION

In the present invention a molded wood flake article includes an integral flexible spring. A molded wood flake support is fabricated to include at least one molded wood flake flexible spring which is narrower than the width of the support and is integral with or secured to the support, wherein the flexible spring can flex independently of the molded wood flake support.

These and other features, advantages and objects of the present invention will be further understood and appreciated by those skilled in the art by reference to the following specification, claims and appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a chair with a plurality of flexible spring members disposed on a back portion thereof according to a preferred embodiment of the present invention;

Fig. 2 is a front view of a molding apparatus with a wood flake mat positioned therebetween before compression;

Fig. 3 is a front view of the molding apparatus of Fig. 2 during compression;

Fig. 4 is a perspective view of the chair back of Fig. 1;

Fig. 5 is a perspective view of a chair seat with a plurality of flexible spring members according to a preferred embodiment of the present invention;

Fig. 6 is a perspective view of a chair according to a another embodiment;

Fig. 7 is a perspective view of a chair according to yet another embodiment;

Fig. 8 is a side view of the chair of Fig. 7, illustrating a deflection of the chair back and flexible spring member;

Fig. 9 is a perspective view of the chair of Fig. 7 including a foam lumbar support and foam covering;

Fig. 10 is a perspective view of a chair according to another embodiment of the present invention;

Fig. 11 is a side view of the chair of Fig. 10;

Fig. 12 is a perspective view of a chair according to yet another embodiment;

Fig. 13 is a perspective view of a sofa including a plurality of flexible spring members disposed on the back portion thereof according to still another embodiment of the present invention; and

Fig. 14 is a side view of the sofa back portion of Fig. 13.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

For purposes of description herein, the terms "upper," "lower," "right," "left," "rear," "front," "vertical," "horizontal," and derivatives thereof shall relate to the invention as orientated in Fig. 1. However, it is to be understood that the invention may assume various alternative orientations, except where expressly specified to the contrary. It is also to be understood that the specific devices and processes illustrated in the attached drawings, and described in the following specification are simply exemplary embodiments of the inventive concepts defined in the appended claims. Hence, specific dimensions and other physical characteristics relating to the embodiments disclosed herein are not to be considered as limiting, unless the claims expressly state otherwise.

In a preferred embodiment of the present invention, a molded wood flake article 2 is fabricated to include flexible spring members 4 wherein the flexible spring members can flex independently from the molded wood flake support. In the preferred embodiment, flexible spring member 4 is molded into support 2 during the fabrication process thereof (Fig. 1).

PROCESS DETAILS:

As best illustrated by Fig. 2, in wood flake or wood strand molding the flakes are molded into three-dimensional, non-planar, configurations by utilizing a mold 10 which forms wood flakes 12 into a molded wood flake part 2. Mold 10 includes a top mold die 16 and a bottom mold die 18. The top mold die 16 includes a surface 20 and at least one extension 22 extending from the surface 20 for forming slots 6 which define the perimeter of flexible spring member 4. The bottom mold die 18 includes a surface 26 having at least one extension receiving cavity 28. The surface 20 of the top mold die 16 and the surface 26 of the bottom mold die 18 define a part forming cavity 30 therebetween which forms part 2 into the desired shape, while extension 22 is configured to extend through molded wood flake part 2 and into cavity 28 to form slot 6, thereby defining at least one flexible spring member 4 which can flex independently from the molded wood flake support or part 2 as illustrated in Fig. 1. Of course, slot 6 may be fabricated by other methods including sawing, cutting, machining and the like.

As illustrated by Figs. 2-3, the molded wood flake part 2 is made by positioning a loosely felted mat 52 of wood flakes 12 on the bottom mold die 18. The top mold die 16 and the bottom mold die 18 are then brought together or closed, wherein heat and pressure are applied to felted mat 52. Felted mat 52 is thereby compressed and cured

into the molded wood flake part 2 having flexible spring member 4 formed therein. In the preferred embodiment, this is accomplished by having extension 22 pass, cut or push through mat 52, forcing wood flakes 12 down into extension receiving cavity 28 to form slots 6. Although only one extension 22 is shown in the illustrated example, a plurality of extensions are typically used to form a plurality of flexible spring members 4 as illustrated in Fig. 1.

The molded wood flake part 2 may include additional features such as "T" nut fastener holes 24 (see Fig. 4). For example as Figs. 2-3 illustrate, extension 56 may be used to make hole 24 and is received within cavity 57. The resulting hole 24 provides a uniform appearance from the surface of the molded wood flake part and facilitates the insertion of a T-nut (not shown) from either surface with its mounting flange and associated bar resting on a surface of the molded wood flake part which has been formed, and with its threaded sleeve projecting inwardly into the hole 24. The width of the hole 24 is sufficiently great throughout its length that it will accommodate a sleeve of a T-nut or other item to be inserted into the hole 24, without interference.

As seen in Fig. 3, the top surface 42 of the molded wood flake part 2 is adjacent the surface 20 of the top mold die 16 and the bottom surface 50 of the molded wood flake part 2 is adjacent the surface 26 of the bottom mold die 18 after the wood flakes 12 have been consolidated, compressed and cured into the molded wood flake part 2. The molded wood flake parts 2 made in this manner will preferably have a nominal thickness 100. However, felted mat 52 will be compressed to varying thicknesses by mold 10, due to unavoidable inconsistencies of mat 52, such as spring back of mat 52, over-compression, or the like. Therefore, the bottom surface 50 of molded wood flake part 2 will be located within a zone of variation in part thickness. The zone of variation in part

thickness is the area in which the bottom surface 50 of the molded wood flake part 2 could be located, depending on the thickness of the molded wood flake part 2, compared to a stationary position for the top surface 42 of the molded wood flake part 2.

The wood flakes 12 used in creating the molded wood flake part 2 can be prepared from various species of suitable hardwoods and softwoods used in the manufacture of particleboard. Representative examples of suitable woods include aspen, maple, oak, elm, balsam fir, pine, cedar, spruce, locust, beech, birch and mixtures thereof. Aspen is preferred.

Suitable wood flakes 12 can be prepared by various conventional techniques. Pulpwood grade logs, or so-called round wood, are converted into wood flakes 12 in one operation with a conventional roundwood flaker. Logging residue or the total tree is first cut into fingerlings having an average length from about 1¼ to about 6 inches, preferably from about 2 to about 3.5 inches with a conventional device, such as the helical comminuting shear disclosed in U.S. Patent No. 4,053,004, and the fingerlings are flaked in a conventional ring-type flaker. Roundwood wood flakes generally are higher quality and produce stronger parts because the lengths and thickness can be more accurately controlled. Also, roundwood wood flakes tend to be somewhat flatter, which facilitates more efficient blending and the logs can be debarked prior to flaking which reduces the amount of less desirable fines produced during flaking and handling. Acceptable wood flakes can be prepared by ring flaking fingerlings. This technique is more readily adaptable to accept wood in poorer form, thereby permitting more complete utilization of certain types of residue and surplus woods.

Irrespective of the particular technique employed for preparing the wood flakes 12, the size distribution of the wood flakes 12 is quite important, particularly the length

and thickness. The wood flakes should have an average length from about 1¼ to about 6 inches, preferably from about 2 to about 3½ inches; an average thickness of about 0.005 to about 0.075 inches, preferably from about 0.015 to about 0.030 inches and more preferably about 0.0020 inch; and an average width of 3 inches or less, most typically 0.25 to 1.0 inches, and never greater than the average length of the flakes. In any given batch, some of the wood flakes 12 can be shorter than 1¼ inch, and some can be longer than 6 inches, so long as the overall average length is within the above range. The same is true for the thickness.

The presence of major quantities of wood flakes 12 having a length shorter than about 1¼ inch tends to cause the felted mat 52 to pull apart during the molding step. The presence of some fines in the felted mat 52 produces a smoother surface and, thus, may be desirable for some applications so long as the majority of the wood flakes, preferably at least 75 percent, is longer than 1⅛ inch and the overall average length is at least 1¼ inch.

Substantial quantities of wood flakes 12 having a thickness of less than about 0.005 inches should be avoided, because excessive amounts of binder are required to obtain adequate bonding. On the other hand, wood flakes 12 having a thickness greater than about 0.075 inch are relatively stiff and tend to overlie each other at some incline when formed into the felted mat 52. Consequently, excessively high mold pressures are required to compress the wood flakes 12 into the desired intimate contact with each other. For wood flakes 12 having a thickness falling within the above range, thinner ones produce a smoother surface while thick ones require less binder. These two factors are balanced against each other for selecting the best average thickness for any particular application.

The width of the wood flakes 12 is less important. The wood flakes 12 should be wide enough to ensure that they lie substantially flat when felted during mat formation. The average width generally should be about 3 inches or less and no greater than the average length. For best results, the majority of the wood flakes 12 should have a width of from about 0.25 to about 1.0 inches.

The blade setting on a flaker can primarily control the thickness of the wood flakes 12. The length and width of the wood flakes 12 are also controlled to a large degree by the flaking operation. For example, when the wood flakes 12 are being prepared by ring flaking fingerlings, the length of the fingerlings generally sets the maximum lengths. Other factors, such as the moisture content of the wood and the amount of bark on the wood affect the amount of fines produced during flaking. Dry wood is more brittle and tends to produce more fines. Bark has a tendency to more readily break down into fines during flaking and subsequent handling than wood.

While the flake size can be controlled to a large degree during the flaking operation as described above, it usually is necessary to use some sort of classification in order to remove undesired particles, both undersized and oversized, and thereby ensure the average length, thickness and width of the wood flakes 12 are within the desired ranges. When roundwood flaking is used, both screen and air classification usually are required to adequately remove both the undersize and oversize particles, whereas fingerling wood flakes usually can be properly sized with only screen classification.

Wood flakes from some green wood can contain up to 90 percent moisture. The moisture content of the mat must be substantially less for molding as discussed below. Also, wet wood flakes tend to stick together and complicate classification and handling prior to blending. Accordingly, the wood flakes 12 are preferably dried prior to

classification in a conventional type drier, such as a tunnel drier, to the moisture content desired for the blending step. The moisture content to which the wood flakes 12 are dried usually is in the order of about 6 weight percent or less, preferably from about 2 to about 5 weight percent, based on the dry weight of the wood flakes 12. If desired, the wood flakes 12 can be dried to a moisture content in the order of 10 to 25 weight percent prior to classification and then dried to the desired moisture content for blending after classification. This two-step drying may reduce the overall energy requirements for drying wood flakes prepared from green woods in a manner producing substantial quantities of particles which must be removed during classification and, thus, need not be as thoroughly dried.

To coat the wood flakes 12 prior to being placed as a felted mat 52 within the cavity 30 of mold 10, a known amount of the dried, classified wood flakes 12 is introduced into a conventional blender, such as a paddle-type batch blender, wherein predetermined amounts of a resinous particle binder, and optionally a wax and other additives, is applied to the wood flakes 12 as they are tumbled or agitated in the blender. As such, the article fabricated from wood flakes 12 is substantially rather than entirely comprised of wood flakes, as other additives as described above are added to create mat 52. Of course, other base materials may also be added to the wood flakes to form a mat 52 comprising a blend of wood flakes 52 and other suitable materials. Suitable binders include those used in the manufacture of particle board and similar pressed fibrous products and, thus, are referred to herein as "resinous particle board binders." Representative examples of suitable binders include thermosetting resins such as phenolformaldehyde, resorcinol-formaldehyde, melamine-formaldehyde, urea-

formaldehyde, urea-furfuryl and condensed furfuryl alcohol resins, and organic polyisocyantes, either alone or combined with urea- or melamine-formaldehyde resins.

Particularly suitable polyisocyanates are those containing at least two active isocyanate groups per molecule, including diphenylmethane diisocyanates, m- and p-phenylene diisocyanates, chlorophenylene diisocyanates, toluene di- and triisocyanates, triphenylmethene triisocyanates, diphenylether-2,4,4'-triisoccyanate and polyphenylpolyisocyanates, particularly diphenylmethane-4,4'-diisocyanate. So-called MDI is particularly preferred.

The amount of binder added to the wood flakes 12 during the blending step depends primarily upon the specific binder used, size, moisture content, type of the wood flakes and the desired characteristics of the part being formed. Generally, the amount of binder added to the wood flakes 12 is from about 3 ½ to about 15 weight percent, preferably from about 4 to about 10 weight percent, and most preferably about 5 percent. When a polyisocyanate is used alone or in combination with a urea-formaldehyde resin, the amounts can be more toward the lower ends of these ranges.

The binder can be admixed with the wood flakes 12 in either dry or liquid form. To maximize coverage of the wood flakes 12, the binder preferably is applied by spraying droplets of the binder in liquid form onto the wood flakes 12 as they are being tumbled or agitated in the blender. When polyisocyantes are used, a conventional mold release agent preferably is applied to the die or to the surface of the felted mat prior to pressing. To improve water resistance of the part, a conventional liquid wax emulsion is also sprayed on the wood flakes 12 during the blinding step. The amount of wax added generally is about 0.5 to about 2 weight percent, as solids, based on the dry weight of the wood flakes 12. Other additives, such as one of the following: a coloring agent,

fire retardant, insecticide, fungicide, mixtures thereof and the like may also be added to the wood flakes 12 during the blending step. The binder, wax and other additives, can be added separately in any sequence or in combined form.

The moistened mixture of binder, wax and wood flakes 12 or "furnish" from the blending step is formed into a loosely-felted, layered mat 52, which is placed within the cavity 30 prior to the molding and curing of the felted mat 52 into molded wood flake part 2. The moisture content of the wood flakes 12 should be controlled within certain limits so as to obtain adequate coating by the binder during the blending step and to enhance binder curing and deformation of the wood flakes 12 during molding.

The presence of moisture in the wood flakes 12 facilitates their bending to make intimate contact with each other and enhances uniform heat transfer throughout the mat during the molding step, thereby ensuring uniform curing. However, excessive amounts of water tend to degrade some binders, particularly urea-formaldehyde resins, and generate steam which can cause blisters. On the other hand, if the wood flakes 12 are too dry, they tend to absorb excessive amounts of the binder, leaving an insufficient amount on the surface to obtain good bonding and the surfaces tend to cause hardening which inhibits the desired chemical reaction between the binder and cellulose in the wood. This latter condition is particularly true for polyisocyanate binders.

Generally, the moisture content of the furnish after completion of blending, including the original moisture content of the wood flakes 12 and the moisture added during blending with the binder, wax and other additives, should be about 5 to about 25 weight percent, preferably about 8 to about 12 weight percent. Generally, higher moisture contents within these ranges can be used for polyisocyanate binders because they do not produce condensation products upon reacting with cellulose in the wood.

The furnish is formed into the generally flat, loosely-felted, mat 52, preferably as multiple layers. A conventional dispensing system, similar to those disclosed in U.S. Pat. Nos. 3,391,223 and 3,824,058, and 4,469,216 can be used to form the felted mat 52. Generally, such a dispensing system includes trays, each having one open side, carried on an endless belt or conveyor and one or more (e.g., three) hoppers spaced above and along the belt in the direction of travel for receiving the furnish.

When a multi-layered felted mat 52 is formed, a plurality of hoppers usually are used with each having a dispensing or forming head extending across the width of the carriage for successively depositing a separate layer of the furnish as the tray is moved beneath the forming heads. Following this, the tray is taken to the mold to place the felted mat within the cavity of bottom mold 18, by sliding the tray out from under mat 52.

In order to produce molded wood flake parts 2 having the desired edge density characteristics without excessive blistering and springback, the felted mat should preferably have a substantially uniform thickness and the wood flakes 12 should lie substantially flat in a horizontal plane parallel to the surface of the carriage and be randomly oriented relative to each other in that plane. The uniformity of the mat thickness can be controlled by depositing two or more layers of the furnish on the carriage and metering the flow of furnish from the forming heads.

Spacing the forming heads above the carriage so the wood flakes 12 must drop from about 1 foot to about 3 feet from the heads en route to the carriage can enhance the desired random orientation of the wood flakes 12. As the flat wood flakes 12 fall from that height, they tend to spiral downwardly and land generally flat in a random pattern. Wider wood flakes within the range discussed above enhance this action. A scalper or

similar device spaced above the carriage can be used to ensure uniform thickness or depth of the mat, however, such means usually tend to align the top layer of wood flakes 12, i.e., eliminate the desired random orientation. Accordingly, the thickness of the mat that would optimally have the nominal part thickness 100 is preferably controlled by closely metering the flow of furnish from the forming heads. The mat thickness that would optimally have the nominal part thickness 100 will vary depending upon such factors as the size and shape of the wood flakes 12, the particular technique used for forming the mat 52, the desired thickness and density of the molded wood flake part 2 produced, the configuration of the molded wood flake part 2, and the molding pressure to be used. However, as discussed above, felted mats 52 will be compressed to varying thicknesses by mold 10 due to unavoidable inconsistencies from mat 52, spring back, over-compression, or the like.

Following the production of the felted mat 52 and placement of the felted mat 52 within the cavity 30 of the mold 10, the felted mat 52 is compressed and cured under heat and pressure when the top mold die 16 engages the bottom mold die 18. Mat 52 is compressed preferably to a density of from about 40 to about 45 pounds per cubic foot, more preferably about 43 pounds per cubic foot. During this molding process, the extension 22 pushes through the binder coated wood flakes 12 of the felted mat 52 and is received by the extension receiving cavity 28. This action forms the slot 6 which defines the perimeter of flexible spring member 4. Any holes 24 will also be created during this molding step as detailed above.

The felted mat 52 is then compressed and cured between the top mold die 16 and the bottom mold 18 to become the molded wood flake part 2. After the molded wood

flake part 2 is produced, any flashing and any plugs are removed by conventional means to reveal flexible spring member 4 and holes 24.

MOLDED WOOD FLAKE ARTICLE DETAILS:

The process as described above can be used to fabricate the molded wood flake article 2 which includes the inventive integral flexible spring member 4, as more particularly described below. In particular, molded wood flake article 2 is fabricated to include at least one flexible spring member 4 which is narrower then the width of the article wherein flexible spring member 4 is disposed. Flexible spring member 4 is fabricated as a cantilevered member and more particularly as a cantilevered spring which can flex independently of the molded wood flake support.

Cantilevered flexible spring member 4 can be used in any article or situation wherein an independently flexible spring member is desired. For example, article 2 may be a molded chair back wherein flexible spring member 4 is molded into the interior thereof to form a support such as a lumbar support. Therefore, the discussion below is directed to the furniture industry. However, this is merely a preferred embodiment and various other articles, both within the furniture industry and outside thereof, may be fabricated using the molded wood flake article with the inventive integrally formed flexible spring member.

In a first embodiment as shown in Figs. 1 and 4, molded wood flake article 2 comprises a chair 60 including a seat portion 62 and a back portion 66. With respect to Fig. 4, back portion 66 includes at least one cantilevered flexible spring member 4 which can independently flex. In the preferred embodiment, a plurality of flexible spring members 4 are illustrated wherein each flexible spring member 4 can flex independently

of each other as well as with respect to seat back 66. Flexible spring members 4 are fabricated by molding, machining, cutting or otherwise creating at least one slot 6 in molded seat back 66 thereby creating the at least one flexible cantilevered member 4 which is narrower then sides 63 and 64 of back portion 66. In the preferred embodiment, a plurality of longitudinal slots 6 are disposed vertically with respect to a vertical axis of seat back 66, and intermediate sides 63 and 64 thereof, to define a plurality of longitudinal flexible spring members 4 laterally disposed adjacently to one another. The flexible spring members 4 are connected, or more particularly integrally formed to the seat back, on one end portion 7 thereof, while the opposite end portion 8 remains free to allow flexation of member 4. Back portion 66 may be installed adjacent the rear of seat portion 62, as illustrated in Fig. 1, thereby providing a chair 60 which includes a flexible back member allowing a user to be comfortably seated therein.

The presence of flexible members 4 allow for turning movement to take place within the chair without having to move the seat thereof. Additionally, flexible members 4 permit back portion 66 to conform to the shape of the user, thereby promoting greater comfort. Further, mounting section 69 of back portion 66 which is disposed adjacent a rear edge 65 of seat portion 62, as well as flexible members 4, can be curved to promote greater support. Further yet, flexible members 4 can be made any length, thereby offering the maximum flexibility and design characteristics which can be tailored as the specific requirements dictate.

In this embodiment, because the total weight disposed against back portion 66 is supported by a plurality of flexible members 4, the total load and/or deflection experienced by a given flexible member 4 will be divided over the total number of flexible members 4 supporting the weight.

The following equations show the expected amount of deflection and sheer stress that a given flexible member 4 should experience. In each equation n = number of flexible members.

$$\Delta \text{ Deflection(flexible member)} = \frac{w\ell^2}{3EI} \div n$$

$$\text{Sheer Stress } S_s\text{(flexible member)} = {}^{3}\!/_{2}\, \frac{(load)}{2BH} \div n$$

where:

D = deflection;

W = 0.18 x (weight of user);

L = length or height of member;

E = elastic modulus of engineered wood;

I = moment of inertia;

B = member thickness; and

H = member height.

Chair 60, and more particularly back portion 66, is fabricated from the aforementioned wood flake molding process. In the preferred embodiment flexible spring members 4 are integrally formed by molding appropriate separators 6 into seat back 66 during the fabrication process as described previously. However, the separators 6 for flexible spring members 4 can be fabricated by numerous other methods such as cutting, machining, sawing, or the like. Thus, when we refer to the spring members as being "integrally formed" with the support, we refer to spring members which are integral with the surrounding support as opposed to being attached thereto by other means such as mechanical fasteners. The thickness of back portion 66 may range from about, preferably, ⅜ inch to ⅝ inch, and more preferably about ½ inch to 9/16 inch.

Further, although flexible spring members 4 have been described with respect to back portion 66, seat portion 62 may also, either alone or in combination with back portion 66, incorporate flexible spring members 4 therein (Fig. 5). Further yet, although the preferred embodiment of back portion 66 is fabricated separately from seat portion 62, both portions may be molded together in a single molding operation thereby creating a one-piece molded chair including a seat portion 62 and a back portion 66 wherein either or both portions may include flexible spring members 4 as illustrated by Fig. 6 (described in more detail below). As such, in the preferred embodiment, a robust yet flexible chair including independently flexible spring members, wherein the members can adjust to the seated user, has been created without adding any additional manufacturing steps or additional parts thereto.

The reference numeral 60A (Fig. 6) generally designates another embodiment of the present invention having an integral seat portion 62A and back portion 66A. Since membrane 60A is similar to the previously-described member 60 similar parts appearing in Figs. 1-5 and Fig. 6, respectively, are represented by the same, corresponding reference numeral, except for the suffix "A" in the numerals of the latter. With respect to Fig. 6, back portion 66A includes a plurality of flexible members 4A and seat portion 62A includes a flexible member 4A', thereby incorporating the integrally formed flexible member in both seat and back portions 62A and 66A, respectively, providing a dual cantilevered chair 60A. Cantilevered seat 62A (with its grain front to back) and cantilevered back 66A (with its grain top to bottom) are constructed in the same manner as previously described. Of course, back member 66A and/or seat member 62A may alternately include a single flexible member or a series of flexible members, respectively.

The reference numeral 60B (Fig. 7) generally designates another embodiment of the present invention having a single down-turned flexible spring member 4B. Since seating article 60B is similar to the previously described article 60, similar parts appearing in Figs. 1-5 and Figs. 7-8, respectively, are represented by the same, corresponding reference numeral, except for the suffix "B" in the numerals of the latter. Chair 60B including a seat portion 62B and a back portion 66B which includes a cantilevered flexible spring member 4B which can independently flex. As described above with respect to the first embodiment 60, flexible spring member 4B may be fabricated by molding, machining, cutting or otherwise creating at least one slot 6B in molded seat back 66B. In the preferred embodiment, a pair of longitudinal slots 6B are disposed vertically with respect to the vertical axis of seat back 66B and intermediate to sides 63B and 64B thereof to define the flexible spring member 4B. Flexible spring member 4B is integrally formed to the back portion on one end portion 7B while the opposite end portion 8B remains free to allow flexation. In this embodiment, free end portion 8B is directed downward as opposed to upwardly turned member 4 and 4A of the prior embodiments. Of course, flex member 4B may be turned in any direction as the specific requirements dictate. In this embodiment, back 66B and seat 62B are attached to one another utilizing brackets 90, thereby providing an additional cantilevered spring within seat 60B. This arrangement thereby provides a fully cantilevered seat 60B.

With respect to Fig. 8, cantilever flexible member 4B displays two modes of cantilever action. Main back portion 67B displays a main deflection D1 relative to seat portion 62, while flexible member 4B displays a deflection D2 relative to main back portion 67B. The deflection of each main back portion 67B and flexible member 4B can be calculated using the same basic set of equations.

$$D = WL^2/3EI$$

where:

D = deflection;

W = 0.18 x (weight of user);

L = length or height of member;

E = elastic modulus of engineered wood; and

I = moment of inertia,

and

$$I = BH^3/12$$

where;

B = member thickness; and

H = member height.

As can be seen from the above equations, D1 and D2 will very relative to one another based solely upon their affective length or height, as all other variables are the same for each equation. The potential total deflection of flexible member 4B is determined by adding D1 and D2 together. Their effects are additive because main back portion 67B acts as a secondary floating cantilever.

As Illustrated by Fig. 9, the preferred embodiment of chair 60B includes a foam member 68 which provides an additional spring member, wherein the combined operation of flexible member 4B and foam member 68 provides chair 60B with ample lumbar support and comfort for a user which is seated therein. Additionally, a layer of main foam 80 and a further layer of fabric (not shown) are also provided to complete back portion 66B of chair 60B.

The reference numeral 60C (Fig. 10) generally designates another embodiment of the present invention having a single down-turned outwardly extending flexible spring

member 4C. Since article 60C is similar to the previously described article 60, similar parts appearing in Figs. 1-5 and Figs. 10-11, respectively, are represented by the same, corresponding reference numeral, except for the suffix "C" in the numerals of the latter. Chair 60C includes a seat portion 62C and a back portion 66C which includes a cantilevered flexible spring member 4C which extends outwardly and can independently flex, thereby creating a lumbar support which extends from the plane of back portion 66C to provide a more supportive structure.

The reference numeral 60D (Fig. 12) generally designates another embodiment of the present invention having an extending flexible spring member 4D. Since article 60D is similar to the previously described article 60, similar parts appearing in Figs. 1-5 and Fig. 12, respectively, are represented by the same, corresponding reference numeral, except for the suffix "D" in the numerals of the latter. In this embodiment flexible spring member 4D includes a free end 8D which terminates into main back portion 67D, thereby surrounding member 4D with main back portion 67D and providing added support to the seated user. In this embodiment the vertical slots 6B and 6C of the previous embodiments has been replaced with a U-shaped slot 9D thereby defining flex member 4D. Again, flexible spring member 4D is integrally formed to the back portion 66D on end portion 7D.

The reference numeral 2E (Fig. 13) generally designates another embodiment of the present invention having a plurality arcuate flexible spring members 4E. Since article 2E is similar to the previously described article 2, similar parts appearing in Figs. 1-5 and Figs. 13-14, respectively, are represented by the same, corresponding reference numeral, except for the suffix "E" in the numerals of the latter. Article 2E comprises a sofa or chair 70 including a back portion 76 which includes a plurality of cantilevered flexible arcuately

shaped members 4E which can independently flex and are designed to replace the metal springs that have been used in the prior art.

As illustrated, flexible spring members 4E include a connected end 7E which is attached, affixed or integrally formed to a base support 77, and a free end 8D which terminates or resides on a foam member 74 attached to a back portion 76. Foam member 74 further enhances the spring effect and quality of flexible spring members 4E and is made of a high density foam which is glued or otherwise affixed to back member 76. As such, foam member 74 prevents any potentially damaging contact between wood springs 4E and back member 76, as well as provides an additional spring element for enhanced support. Of course, foam member 74 and back member 76 may be omitted to provide a plurality of ends 8D which are free to flex as described in the previous embodiments.

In the preferred embodiment of sofa back 76, interconnecting each flexible member 4D and located approximately ⅓ of the distance up from base 77 is lumbar foam spring 78. Similar to the connection between top foam member 74 and back member 76, lumbar foam spring 78 is advantageously connected to each of the plurality of flexible members 4E and offers the additional advantage of providing a lumbar support for the back of a given user. Further, by being interconnected with flexible members 4E, lumbar foam member 78 allows for flexible members 4E to operate in unison, more so than would be possible if no interconnection was provided therebetween. Additionally, a foam sheet 75 covers flexible members 4D and lumbar foam member 78, wherein foam material 75 is formed from a flat sheet of foam (Fig. 14). Such a foam material is relatively inexpensive as it does not need to be pre-shaped or provided with a particular contour. Instead, in the course of mounting it in place with a fabric covering 79, foam material 75 takes the appropriate shape needed. An additional advantage associated with foam material 75 is that is can be manufactured to any desired size and length and/or can be cut from a larger

sheet of foam. The "cushiony" feel provided by the combination of foam sheet 75, lumbar foam member 78, top foam member 74 and flexible members 4E eliminate the need for batting to achieve the desire degree of softness. This is especially advantageous since the elimination of the batting between the foam slab and the fabric reduces the material and/or labor costs of constructing sofa back 76.

In a preferred embodiment, a single foam members is used for member 74 and 78 which extends across flexible members 4E. These members may be fabricated from numerous materials which are commonly known within the art. However, the type of foam ideally used is a 2.5 – 3.0 pound foam.

Although not illustrated in Figs. 13 and 14, it is to be understood that wood springs 4E could be formed so as to be integral with base member 77 along ends 7C, thereby producing a comb type shape.

In the above embodiments, a molded wood flake support member has been described which includes an integrally formed molded wood flake flexible spring. The flexible spring member acts as a cantilevered spring thereby flexibly supporting the user that is seated therein. The above embodiments have been particularly directed to the furniture industry and more particularly to the seating industry. However, these embodiments represent only the preferred embodiments and are not meant to be limiting in any manner. The above inventive integral flexible spring can be utilized in various ways and be fabricated into varied articles. Hence, the above description is that of the preferred embodiments only. Modifications of the invention will occur to those skilled in the art and to those who make or use the invention. Therefore, it is understood that the embodiment described above is merely for illustrative purposes and not intended to limit the scope of the invention, which is defined by the following claims as interpreted according to the principles of patent law, including the Doctrine of Equivalents.

The invention claimed is:

1. A molded wood flake support comprising:

a width; and

at least one molded wood flake flexible spring which is narrower than said width of said support, said flexible spring including a free end and a joined end, said joined end being integrally formed with said support;

wherein said flexible spring can flex independently from said support.

2. A support according to claim 1, wherein said support is fabricated substantially of wood flakes.

3. A support according to claim 1, wherein said wood flakes have an average length of from about 1.25 inches to about 6 inches, an average thickness of from about 0.005 inches to about 0.075 inches, and an average width from about 3.0 inches or less.

4. A support according to claim 3, wherein said wood flakes have an average length of from about 2 inches to about 3 inches.

5. A support according to claim 3, wherein said wood flakes have an average thickness of from about 0.015 inches to about 0.030 inches.

6. A support according to claim 3, wherein said wood flakes have an average width of from about 0.25 inches to about 1.0 inch, and never greater than the average length of said wood flakes.

7. A support according to claim 1, wherein said support includes a plurality of molded wood flake flexible springs.

8. A support according to claim 7, wherein said plurality of molded wood flake flexible springs are laterally adjacently disposed on said support.

9. A support according to claim 1, wherein said at least one molded wood flake flexible spring is U-shaped.

10. A support according to claim 1, wherein:

said support includes an edge; and

said free end of said at least one molded wood flake flexible spring is disposed interiorly of said edge.

11. A support according to claim 1, wherein:

said support comprises a seating article including a seat portion; and

said at least one molded wood flake flexible spring is disposed within the seat portion of the seating article.

12. A support according to claim 1, wherein:

said support comprises a seating article including a back portion; and

said at least one molded wood flake flexible spring is disposed within the back portion of the seating article.

13. A support according to claim 12, wherein:

said back portion includes a seat facing side; and

said at least one molded wood flake flexible spring extends outwardly from said seat facing side of said back portion.

14. A support according to claim 1, wherein:

said support includes at least one channel disposed therein, said at least one channel defining said at least one molded wood flake flexible spring; and

said at least one channel is integrally molded within said support.

15. A molded wood flake support for a seating article which at least partially supports a seated user thereon, said molded wood flake support comprising:

a molded support at least partially comprising wood flakes, said support including a width; and

at least one molded wood flake flexible spring which is narrower than said width of said support, said flexible spring including a free end and a joined end, said joined end being integrally formed with said support;

wherein said flexible spring can flex independently from said support.

16. A support according to claim 15, wherein said support is fabricated substantially of wood flakes.

17. A support according to claim 15, wherein said wood flakes have an average length of from about 1.25 inches to about 6 inches, an average thickness of from about 0.005 inches to about 0.075 inches, and an average width from about 3.0 inches or less.

18. A support according to claim 17, wherein said wood flakes have an average length of from about 2 inches to about 3 inches.

19. A support according to claim 17, wherein said wood flakes have an average thickness of from about 0.015 inches to about 0.030 inches.

20. A support according to claim 17, wherein said wood flakes have an average width of from about 0.25 inches to about 1.0 inch, and never greater than the average length of said wood flakes.

21. A support according to claim 15, wherein said support includes a plurality of molded wood flake flexible springs.

22. A support according to claim 21, wherein said plurality of molded wood flake flexible springs are laterally adjacently disposed on said support.

23. A support according to claim 15, wherein said at least one molded wood flake flexible spring is U-shaped.

24. A support according to claim 15, wherein:

said support includes an edge; and

said free end of said at least one molded wood flake flexible spring is disposed interiorly of said edge.

25. A support according to claim 15, wherein:

said support comprises a seating article including a seat portion; and

said at least one molded wood flake flexible spring is disposed within the seat portion of the seating article.

26. A support according to claim 15, wherein:

said support comprises a seating article including a back portion; and

said at least one molded wood flake flexible spring is disposed within the back portion of the seating article.

27. A support according to claim 26, wherein:

said back portion includes a seat facing side; and

said at least one molded wood flake flexible spring extends outwardly from said seat facing side of said back portion.

28. A support according to claim 15, wherein:

said support includes at least one channel disposed therein, said at least one channel defining said at least one molded wood flake flexible spring; and

said at least one channel is integrally molded within said support.

29. A seating article comprising:

a seat portion adapted to support a seated user thereon and a back portion adapted to support the seated user in an upright position, at least one of said seat portion and said back portion at least partially molded from wood flakes; and

at least one of said seat portion and said back portion which is at least partially molded from wood flakes comprising at least one molded wood flake flexible spring which is narrower than a width of the seat portion or back portion of which the flexible spring is comprised, said flexible spring including a free end and a joined end, said joined end being integrally formed with said at least one of said seat portion or said back portion;

wherein said at least one flexible spring can flex independently of said seat portion or said back portion.

30. A seating article according to claim 29, wherein said seat portion and said back portion are integrally formed as a one-piece seating article.

31. A seating article according to claim 29, wherein said wood flakes have an average length of from about 1.25 inches to about 6 inches, an average thickness of from about 0.005 inches to about 0.075 inches, and an average width from about 3.0 inches or less.

32. A seating article according to claim 31, wherein said wood flakes have an average length of from about 2 inches to about 3 inches.

33. A seating article according to claim 31, wherein said wood flakes have an average thickness of from about 0.015 inches to about 0.030 inches.

34. A seating article according to claim 31, wherein said wood flakes have an average width of from about 0.25 inches to about 1.0 inch, and never greater than the average length of said wood flakes.

35. A seating article according to claim 29, wherein said at least one of said seat portion and said back portion which is at least partially molded from wood flakes includes a plurality of molded wood flake flexible springs.

36. A seating article according to claim 35, wherein said plurality of molded wood flake flexible springs are laterally adjacently disposed on said seat or back portion.

37. A seating article according to claim 29, wherein said at least one molded wood flake flexible spring is U-shaped.

38. A seating article according to claim 29, wherein:

said at least one of said seat portion and said back portion which is at least partially molded from wood flakes and comprises at least one molded wood flake flexible spring, includes an edge; and

said free end of said at least one molded wood flake flexible spring is disposed interiorly of said edge.

39. A seating article according to claim 29, wherein:

said at least one of said seat portion and said back portion which is at least partially molded from wood flakes comprises at least one molded wood flake flexible spring which extends outwardly from said seat portion or said back portion.

40. A seating article according to claim 29, wherein:

said at least one of said seat portion and said back portion which is at least partially molded from wood flakes and comprises at least one molded wood flake flexible spring

includes at least one channel disposed therein, said at least one channel defining said at least one molded wood flake flexible spring; and

said at least one channel integrally molded within said seat or back portion.

41. A seating article comprising:

a seat portion adapted to support a seated user thereon and a back portion adapted to support the seated user in an upright position, at least one of said seat portion and said back portion molded at least partially from wood flakes, said seat portion and said back portion having a width; and

said at least one of said seat portion and said back portion which is molded at least partially from wood flakes comprises at least one cantilevered spring integrally molded therein, said cantilevered spring being narrower than said width of said support comprising said spring, said cantilevered spring including a free end and a joined end, said joined end being integrally molded with said at least one of said seat portion or said back portion;

wherein said at least one flexible spring can flex independently of said seat portion or said back portion.

42. A seating article according to claim 41, wherein said wood flakes have an average length of from about 1.25 inches to about 6 inches, an average thickness of from about 0.005 inches to about 0.075 inches, and an average width from about 3.0 inches or less.

43. A seating article according to claim 42, wherein said wood flakes have an average length of from about 2 inches to about 3 inches.

44. A seating article according to claim 42, wherein said wood flakes have an average thickness of from about 0.015 inches to about 0.030 inches.

45. A seating article according to claim 42, wherein said wood flakes have an average width of from about 0.25 inches to about 1.0 inch, and never greater than the average length of said wood flakes.

46. A seating article according to claim 41, wherein said at least one of said seat portion and said back portion which is at least partially molded from wood flakes includes a plurality of molded cantilevered springs.

47. A seating article according to claim 46, wherein said plurality of molded cantilevered springs are laterally adjacently disposed on said seat or back portion.

48. A seating article according to claim 41, wherein said at least one molded cantilevered spring is U-shaped.

49. A seating article according to claim 41, wherein:

said at least one of said seat portion and said back portion which is at least partially molded from wood flakes and comprises at least one molded cantilevered spring, includes an edge; and

said free end of said at least one molded cantilevered spring is disposed interiorly of said edge.

50. A seating article according to claim 41, wherein:

said at least one of said seat portion and said back portion which is at least partially molded from wood flakes comprises at least one molded cantilevered spring which extends outwardly from said seat portion or said back portion.

51. A seating article according to claim 41, wherein:

said at least one of said seat portion and said back portion which is at least partially molded from wood flakes and comprises at least one molded wood cantilevered spring includes at least one channel disposed therein, said at least one channel defining said at least one molded cantilevered spring; and

said at least one channel is integrally molded within said seat or back portion.

52. A method of molding a wood flake article including a flexible springs therein, comprising:

forming a loosely felted mat at least partially from wood flakes;

providing a press including an upper portion and a lower portion;

depositing said mat into said lower portion of a press;

providing one of said upper portion of said press or said lower portion of said press with a flexible spring forming extension which projects from said upper portion or said lower portion of said press;

providing the other of said upper portion or said lower portion of said press with a flexible spring forming cavity for receiving said flexible spring forming extension, said upper portion and said lower portion forming an article defining cavity therebetween;

compressing said mat between said upper portion and said lower portion, whereby said flexible spring forming extension presses said mat in contact with said flexible spring forming extension into said flexible spring forming cavity; and

heating said mat in said press;

whereby said upper portion and said lower portion of said press form a support therebetween comprising a flexible spring defined by a perimeter which is formed by said flexible spring forming extension and said flexible spring forming cavity, said perimeter defining said flexible spring.

53. The method according to claim 52, wherein:

said forming a loosely felted mat step includes providing wood flakes with an average length of from about 1.25 inches to about 6 inches, an average thickness of from about 0.005 inches to about 0.075 inches, and an average width from about 3.0 inches or less.

54. The method according to claim 53, wherein:

said forming a loosely felted mat step includes providing wood flakes with an average length of from about 2 inches to about 3 inches.

55. The method according to claim 53, wherein:

said forming a loosely felted mat step includes providing wood flakes with an average thickness of from about 0.015 inches to about 0.030 inches.

56. The method according to claim 53, wherein:

said forming a loosely felted mat step includes providing wood flakes with an average width of from about 0.25 inches to about 1.0 inch, and never greater than the average length of said wood flakes.

57. A support comprising:

a width; and

at least one molded wood flake flexible spring which is narrower than said width of said support, said flexible spring including a free end and a joined end, said joined end being affixed to said support;

wherein said flexible spring can flex independently from said support.

58. A support according to claim 57, wherein said wood flakes have an average length of from about 1.25 inches to about 6 inches, an average thickness of from about 0.005 inches to about 0.075 inches, and an average width from about 3.0 inches or less.

59. A support according to claim 58, wherein said wood flakes have an average length of from about 2 inches to about 3 inches.

60. A support according to claim 58, wherein said wood flakes have an average thickness of from about 0.015 inches to about 0.030 inches.

61. A support according to claim 58, wherein said wood flakes have an average width of from about 0.25 inches to about 1.0 inch, and never greater than the average length of said wood flakes.

62. A support according to claim 57, wherein said support includes a plurality of molded wood flake flexible springs.

63. A support according to claim 62, wherein said plurality of molded wood flake flexible springs are laterally adjacently disposed on said support.

64. A support according to claim 57, wherein:

said support comprises a seating article including a back support portion; and

said at least one molded wood flake flexible spring is affixed to the back support portion of the seating article.

65. A support according to claim 64, wherein:

said seating article comprises a couch .

66. A support according to claim 65, wherein:

said at least one molded wood flake flexible spring is integral with said back support portion.

67. A support according to claim 65, wherein:

said back support portion includes a seat facing side; and

said at least one molded wood flake flexible spring extends outwardly from said seat facing side of said back support portion.

MOLDED WOOD FLAKE ARTICLE WITH INTEGRAL FLEXIBLE SPRING MEMBER

ABSTRACT OF THE DISCLOSURE

A molded wood flake support is fabricated to include at least one flexible spring member which is narrower then the width of the molded wood flake support and integrally formed therewith or secured thereto, wherein the flexible spring member can flex independently from the molded wood flake support.

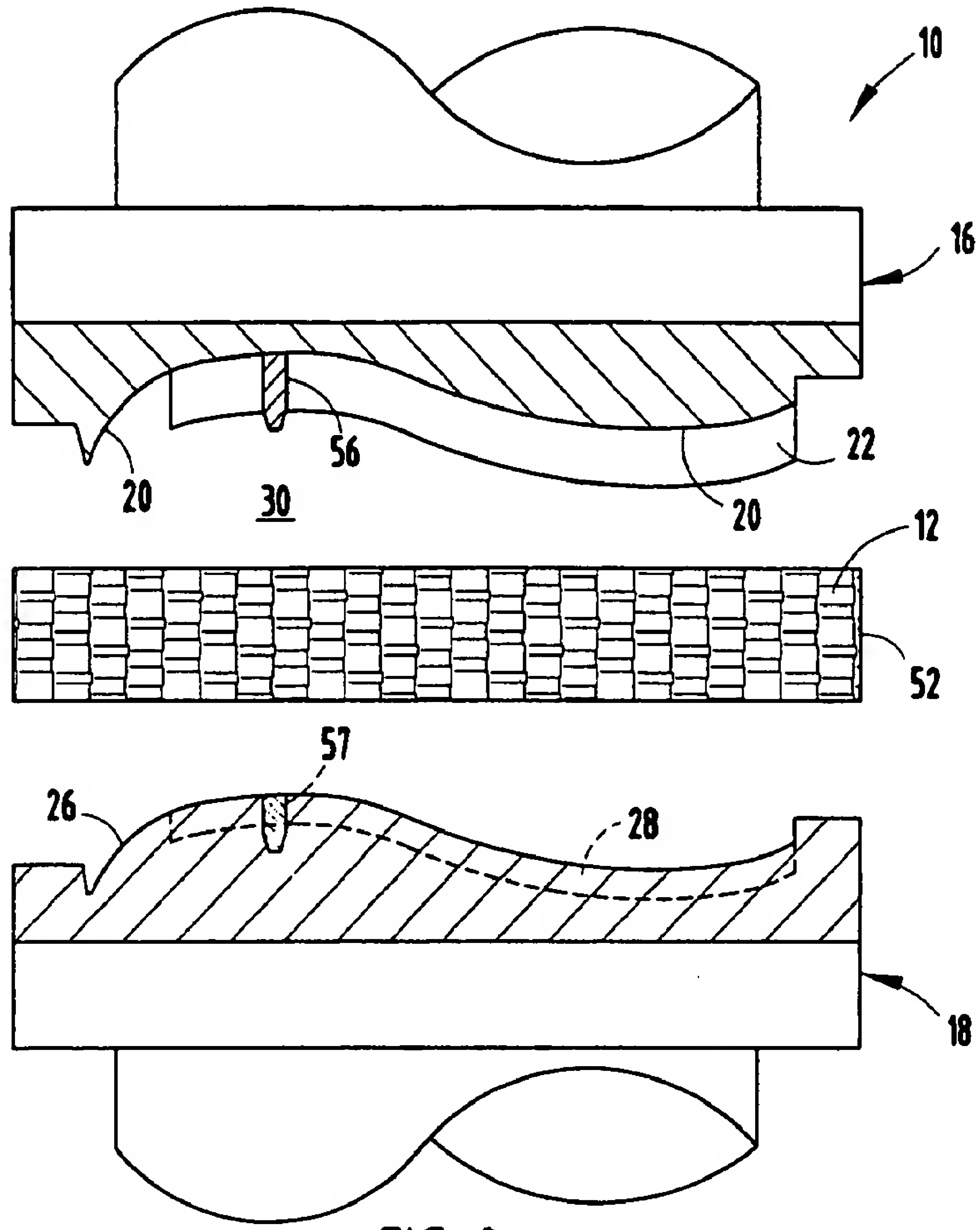

FIG. 2

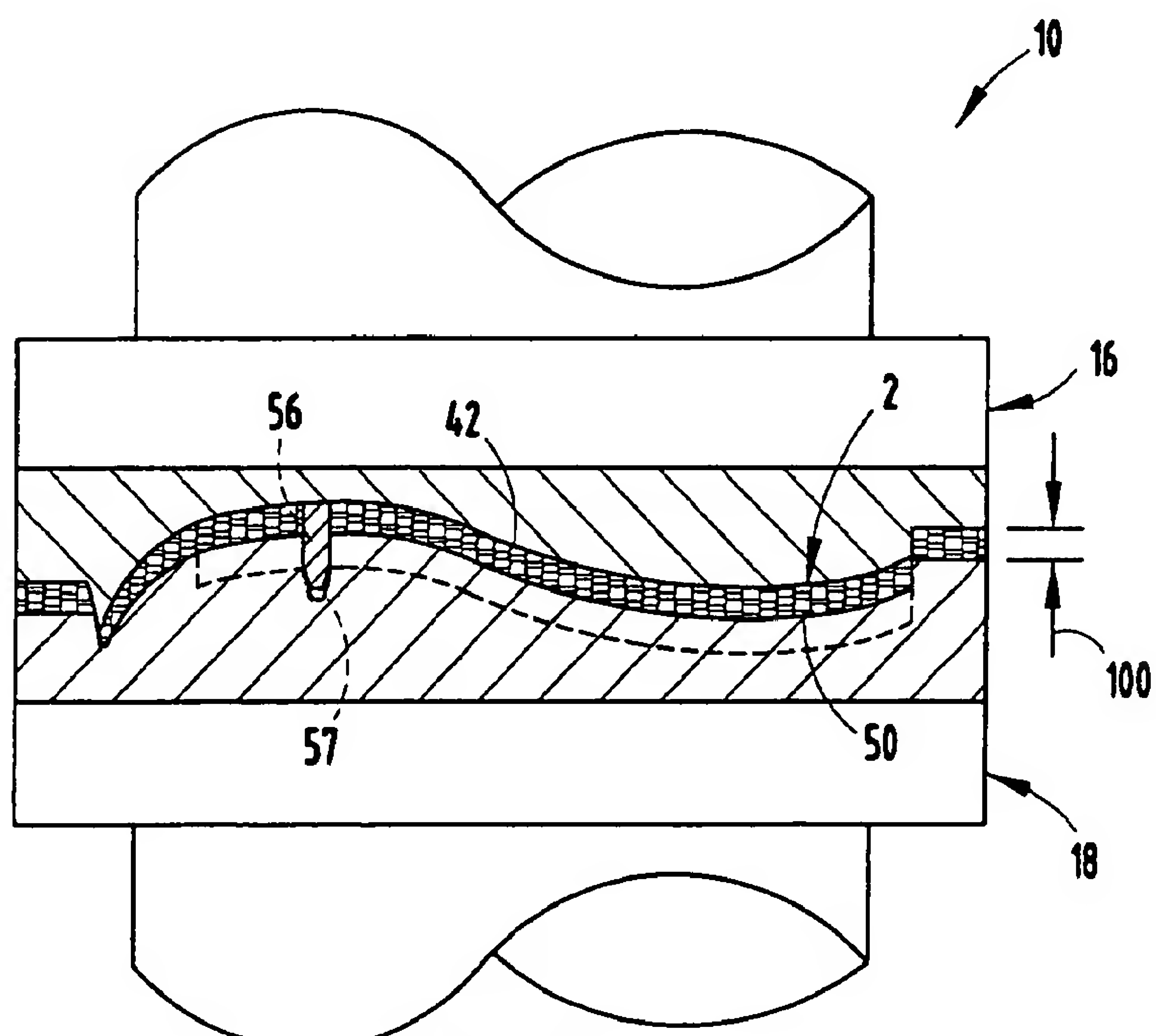

FIG. 3

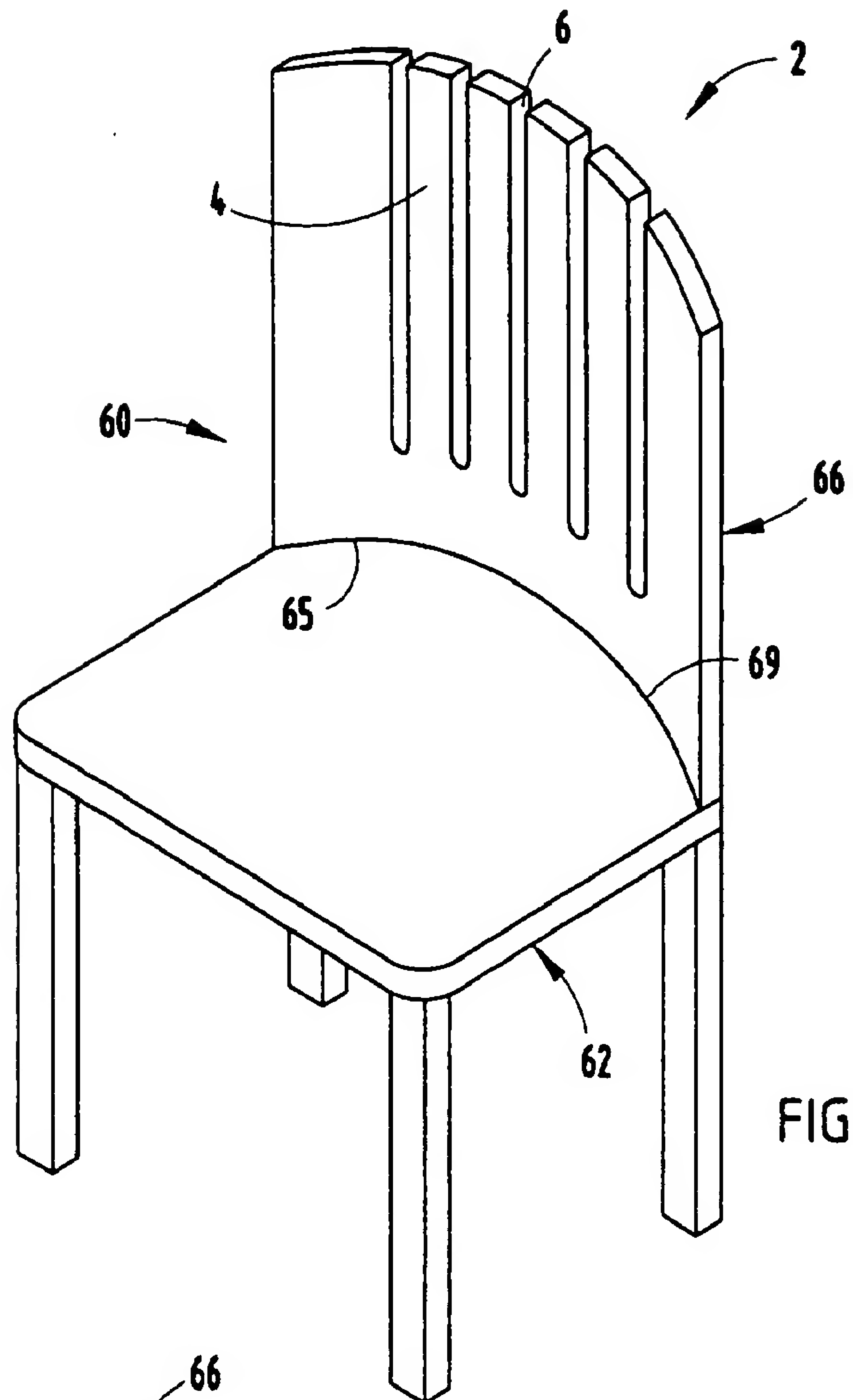

FIG. 1

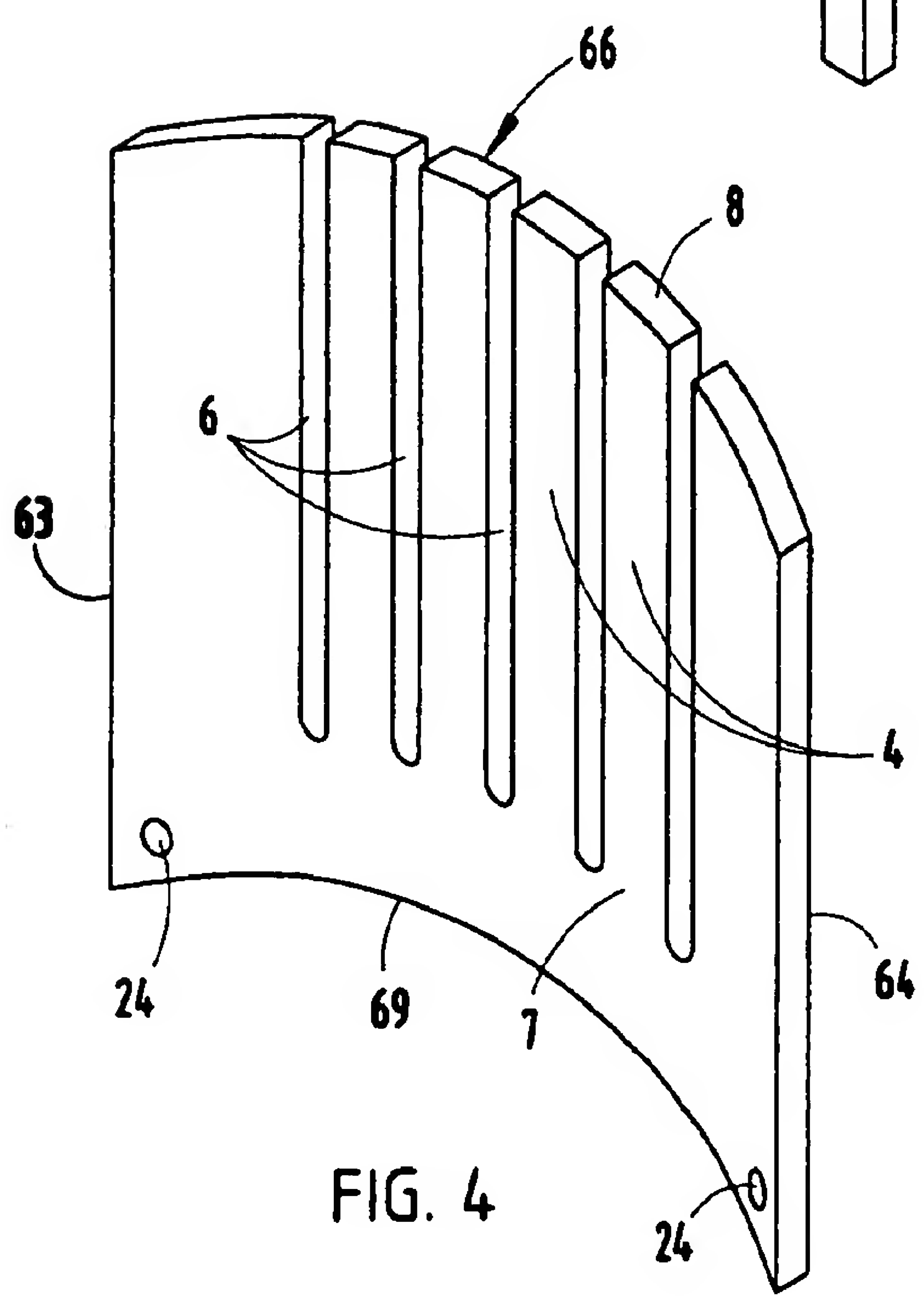

FIG. 4

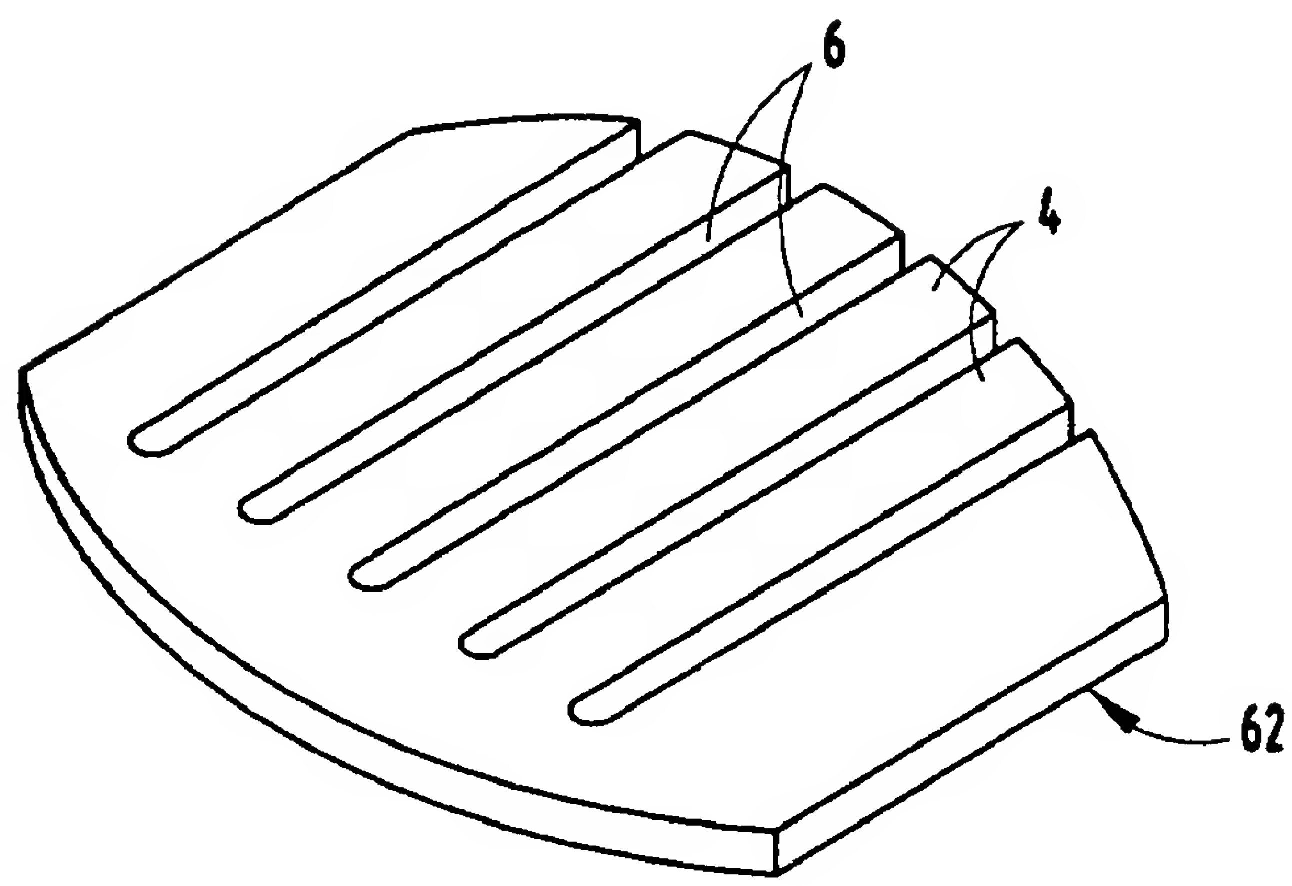

FIG. 5

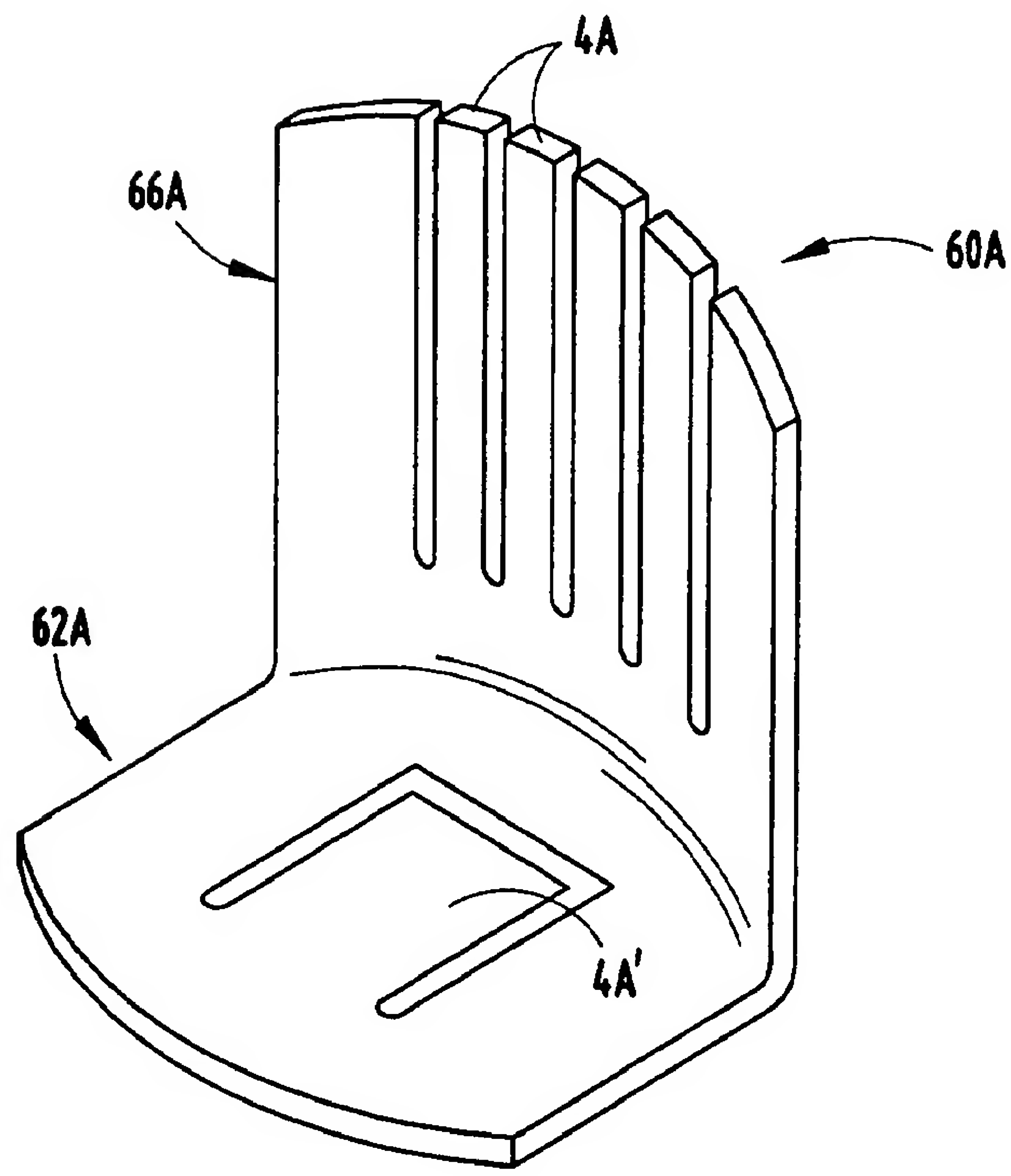

FIG. 6

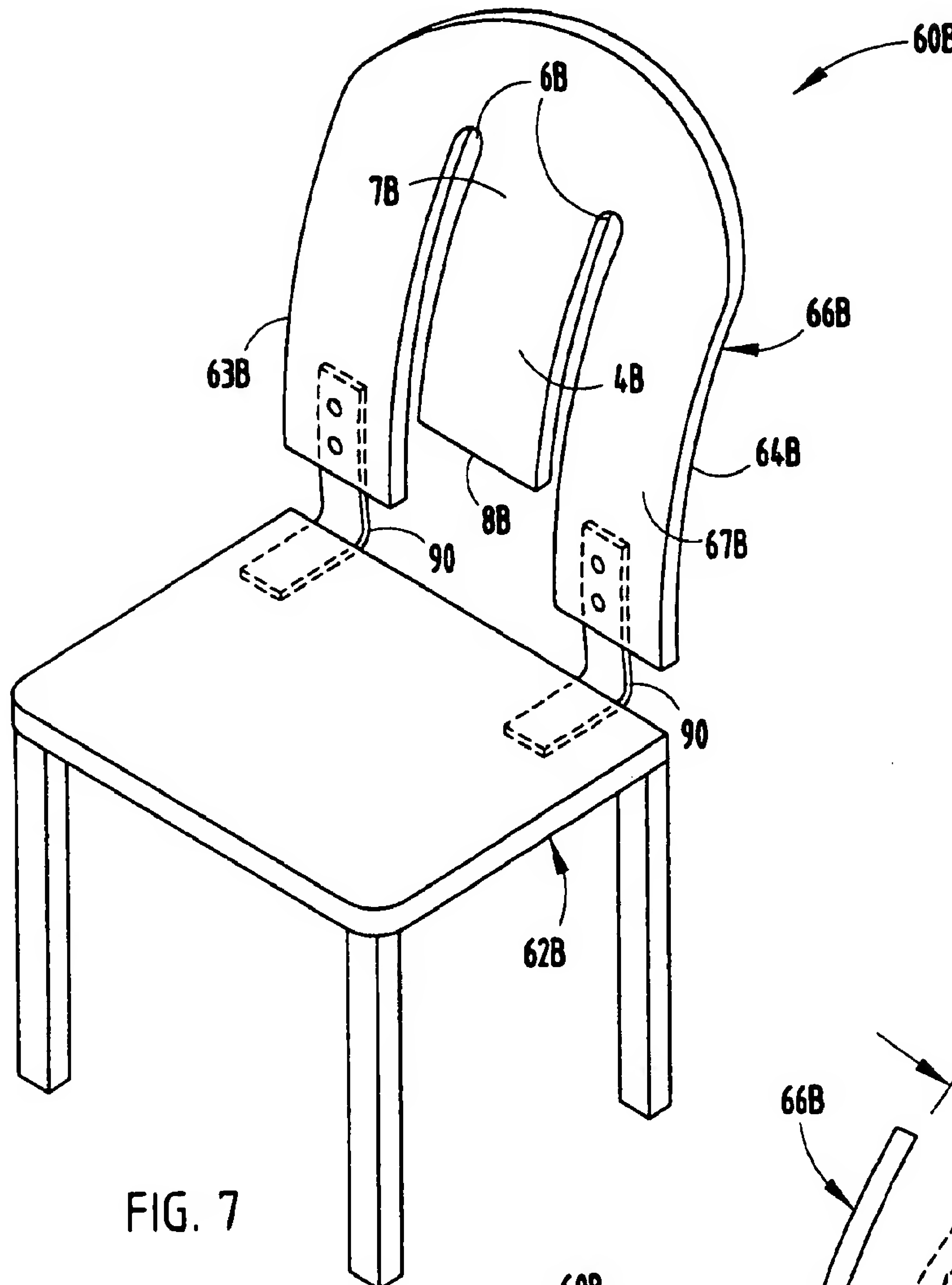
60B
6B
7B
66B
63B
4B
64B
8B
67B
90
90
62B

FIG. 7

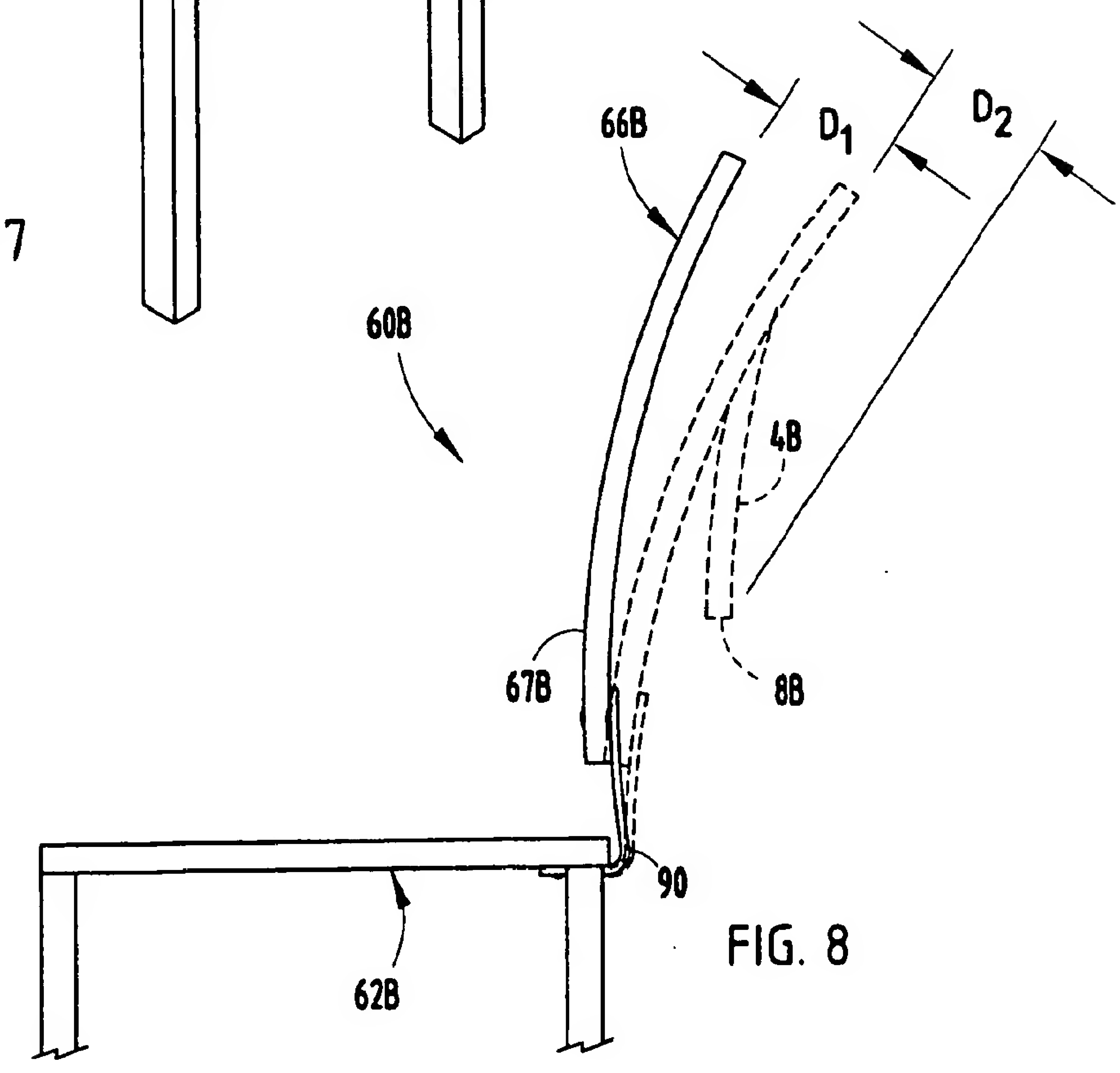
66B
D1
D2
60B
4B
67B
8B
90
62B

FIG. 8

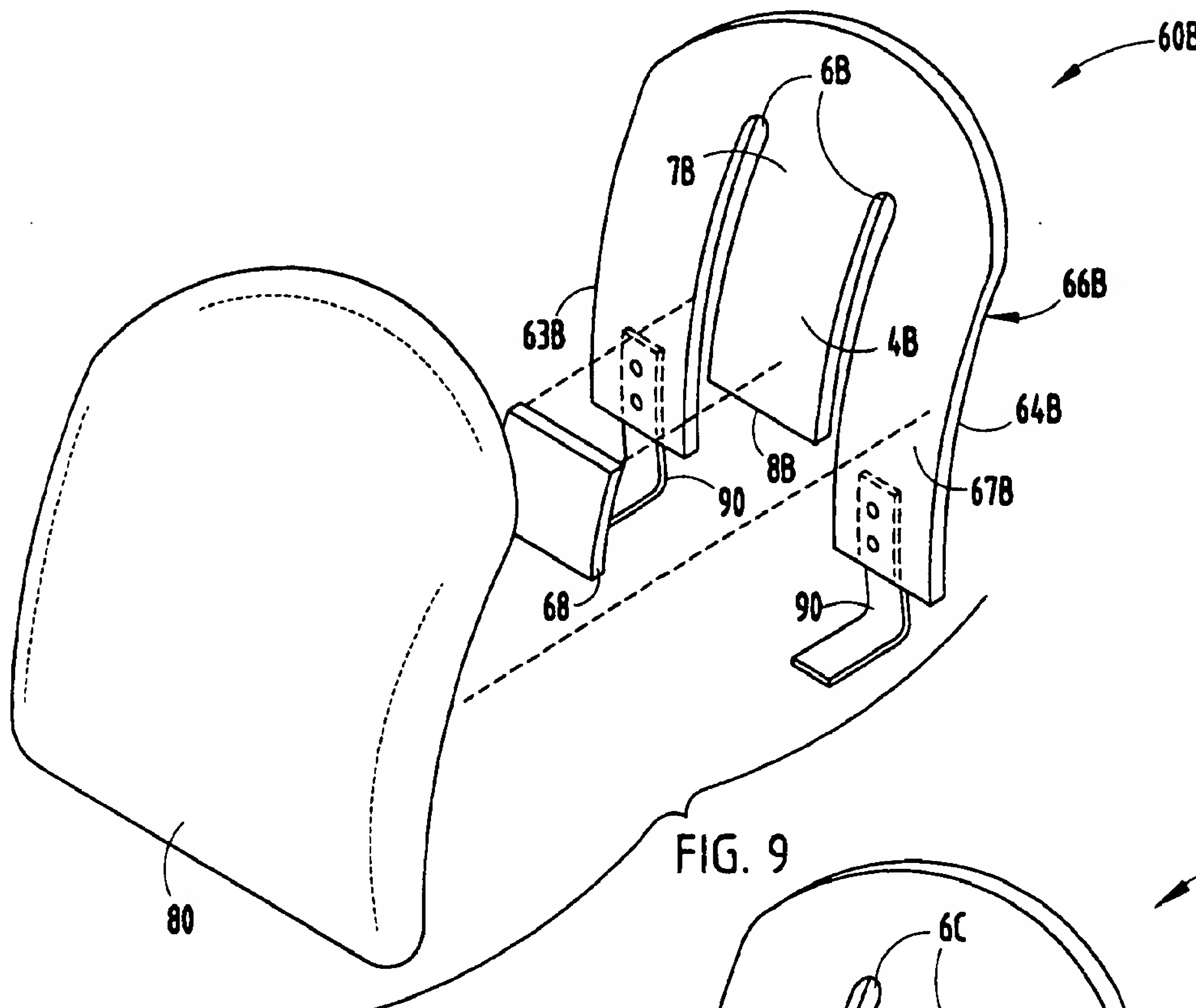
60B
6B
7B
66B
63B
4B
64B
8B
90
67B
68
90
80

FIG. 9

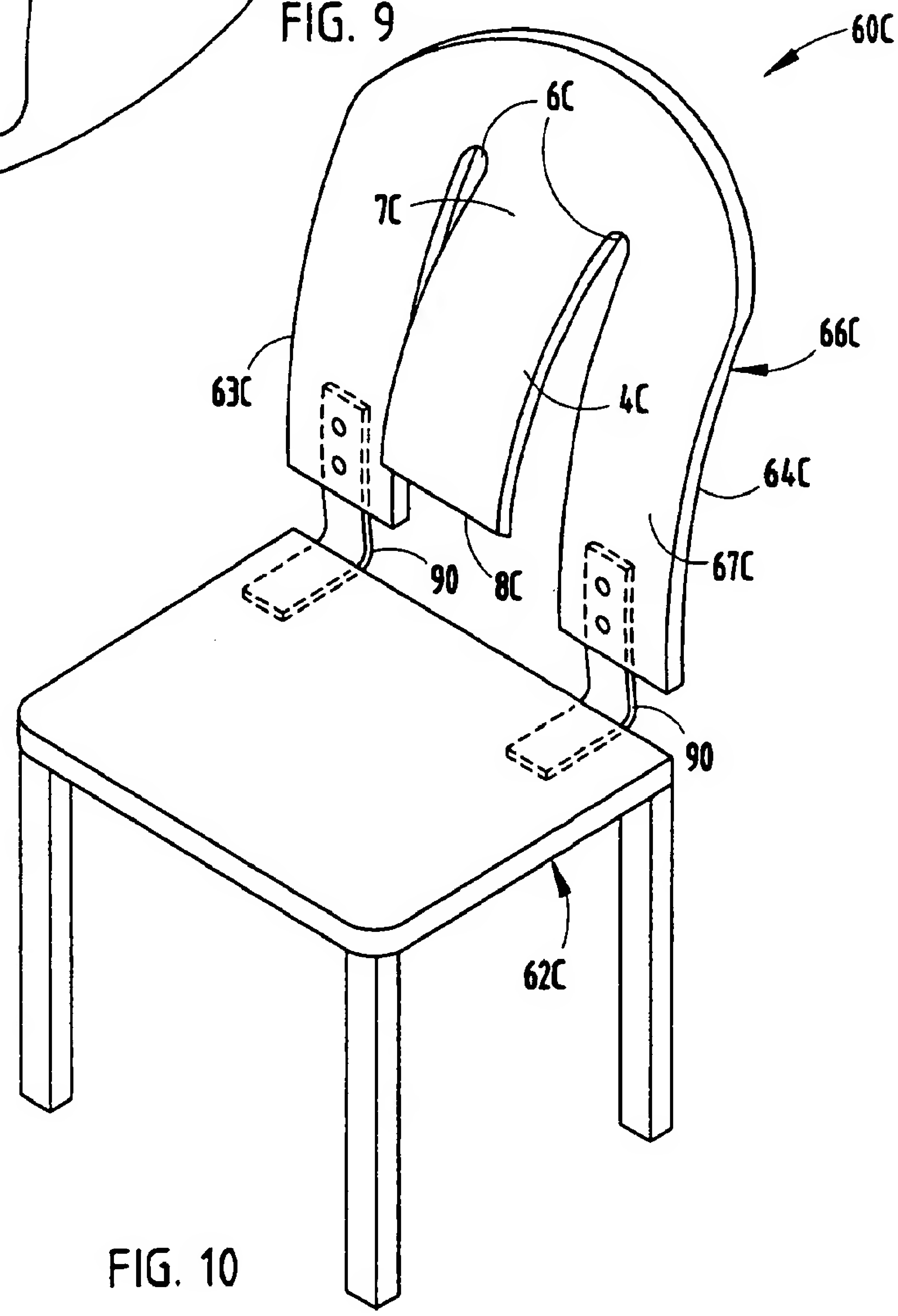
60C
6C
7C
66C
63C
4C
64C
90
8C
67C
90
62C

FIG. 10

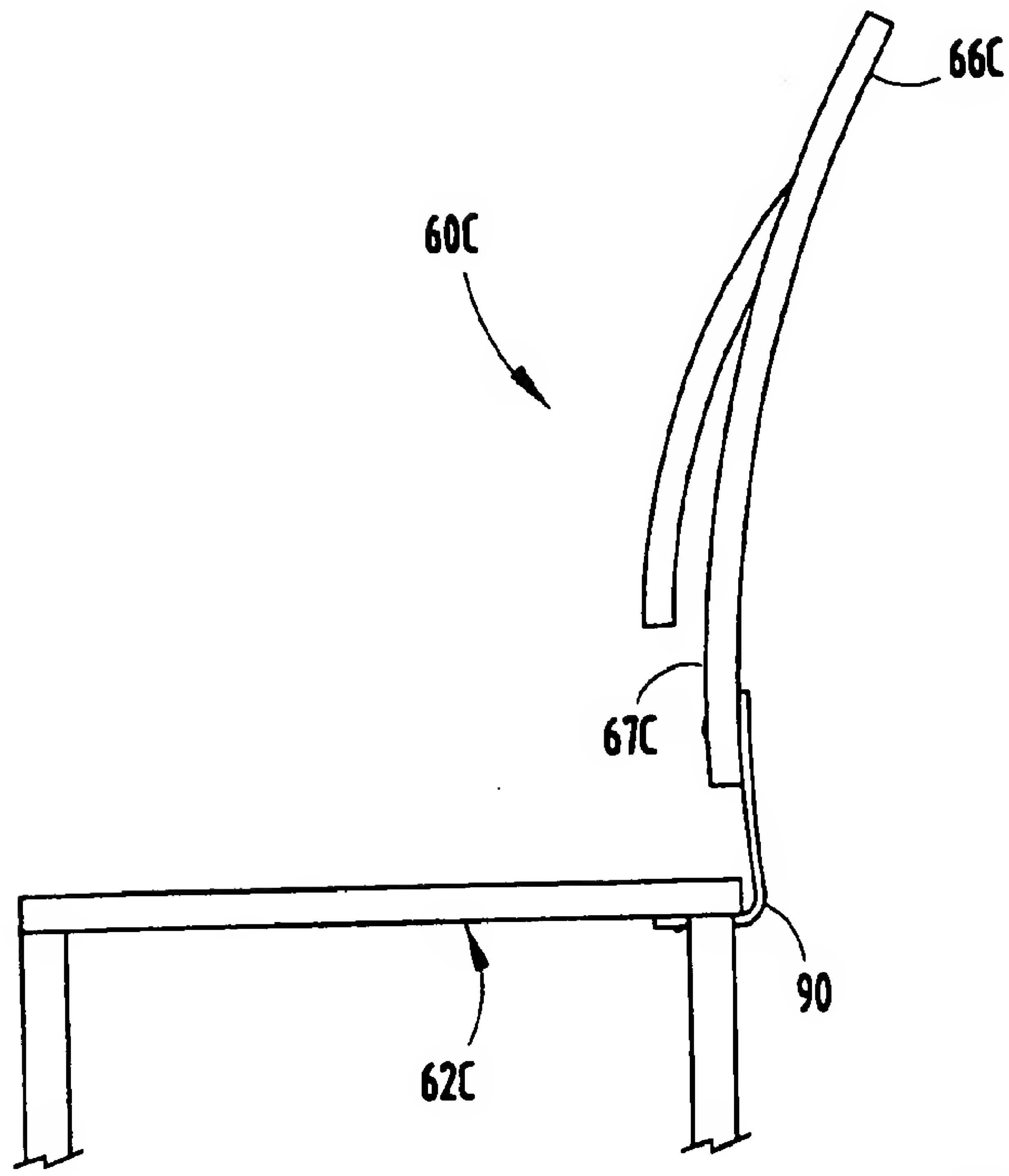

FIG. 11

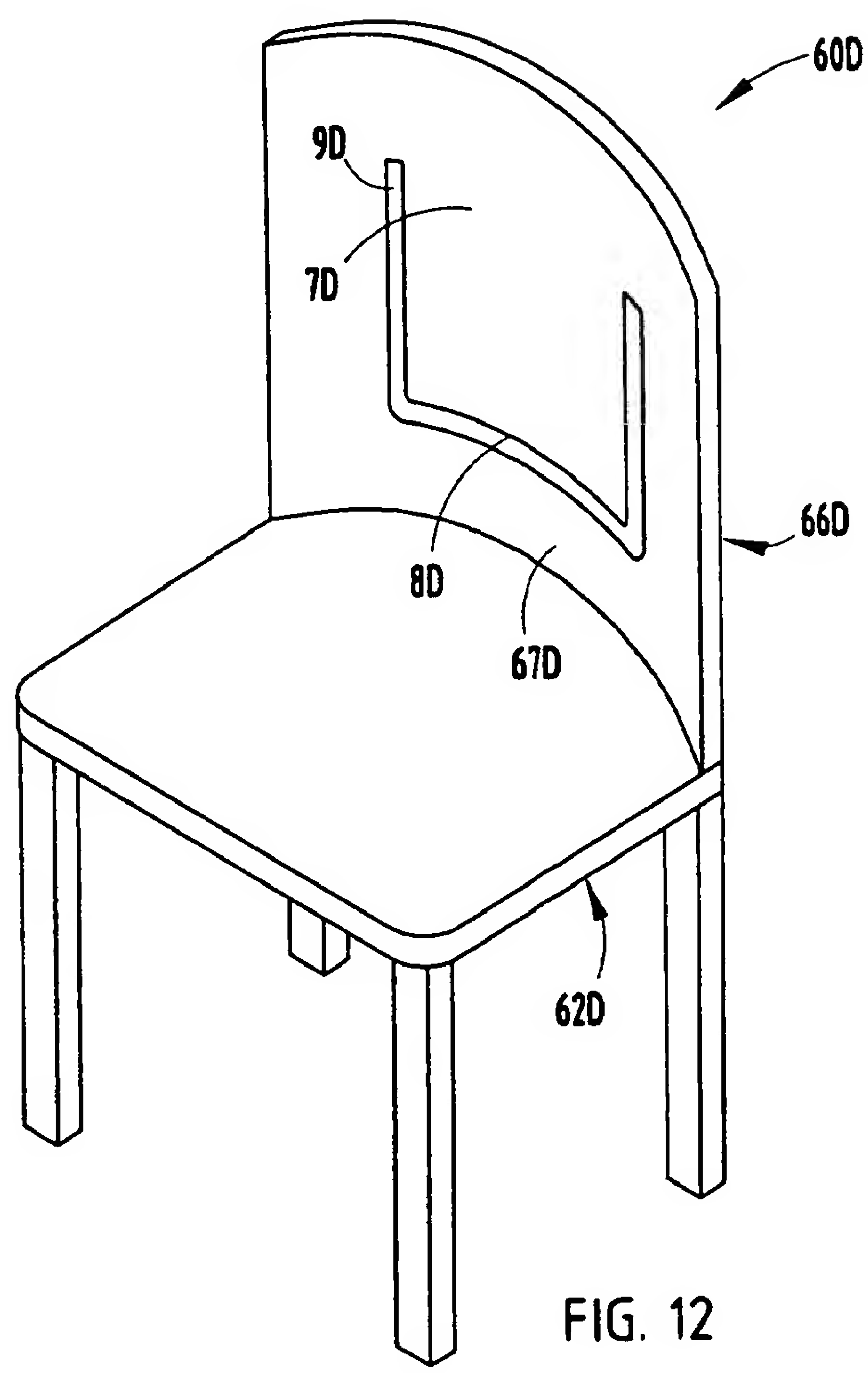

FIG. 12

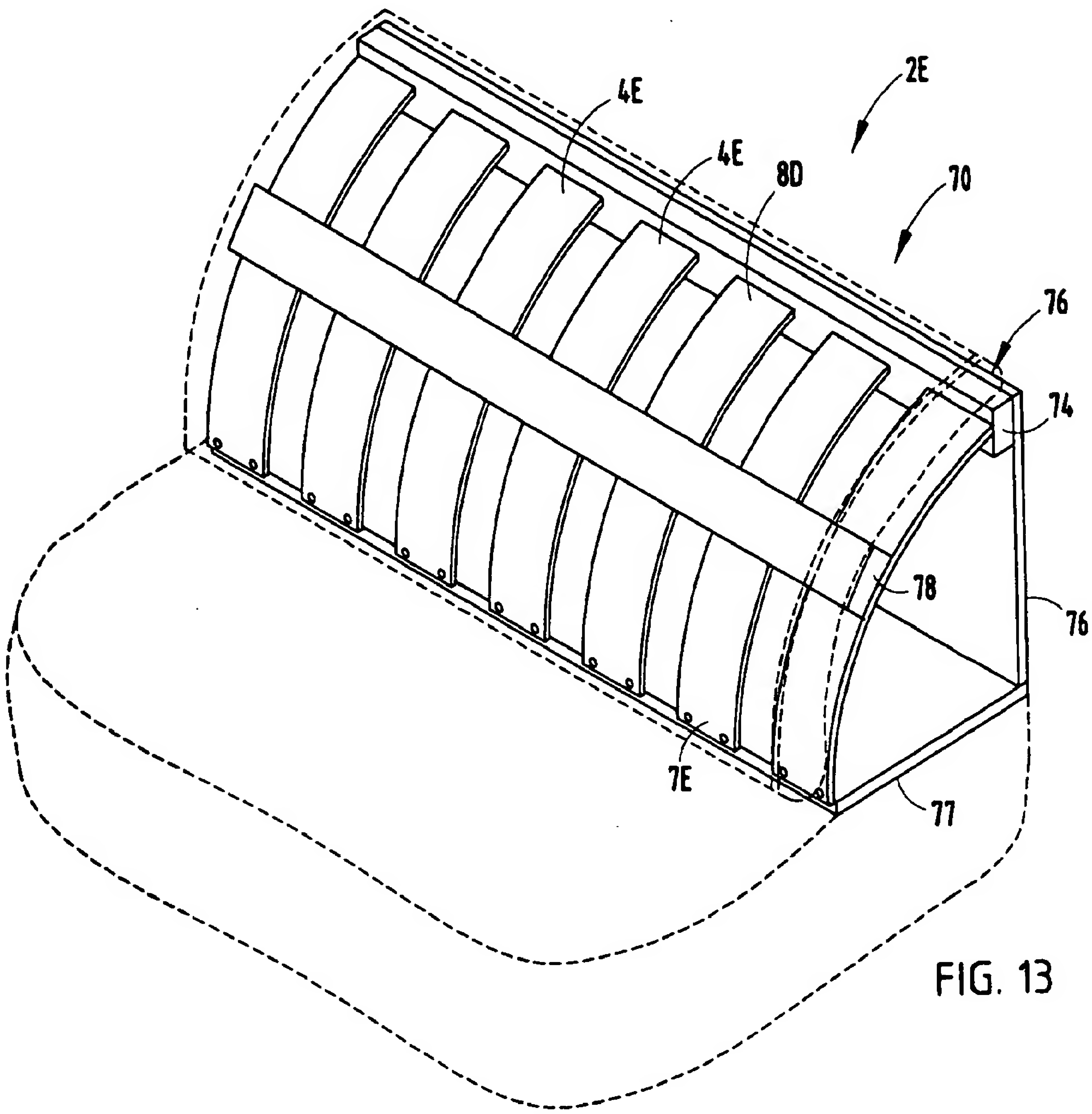

FIG. 13

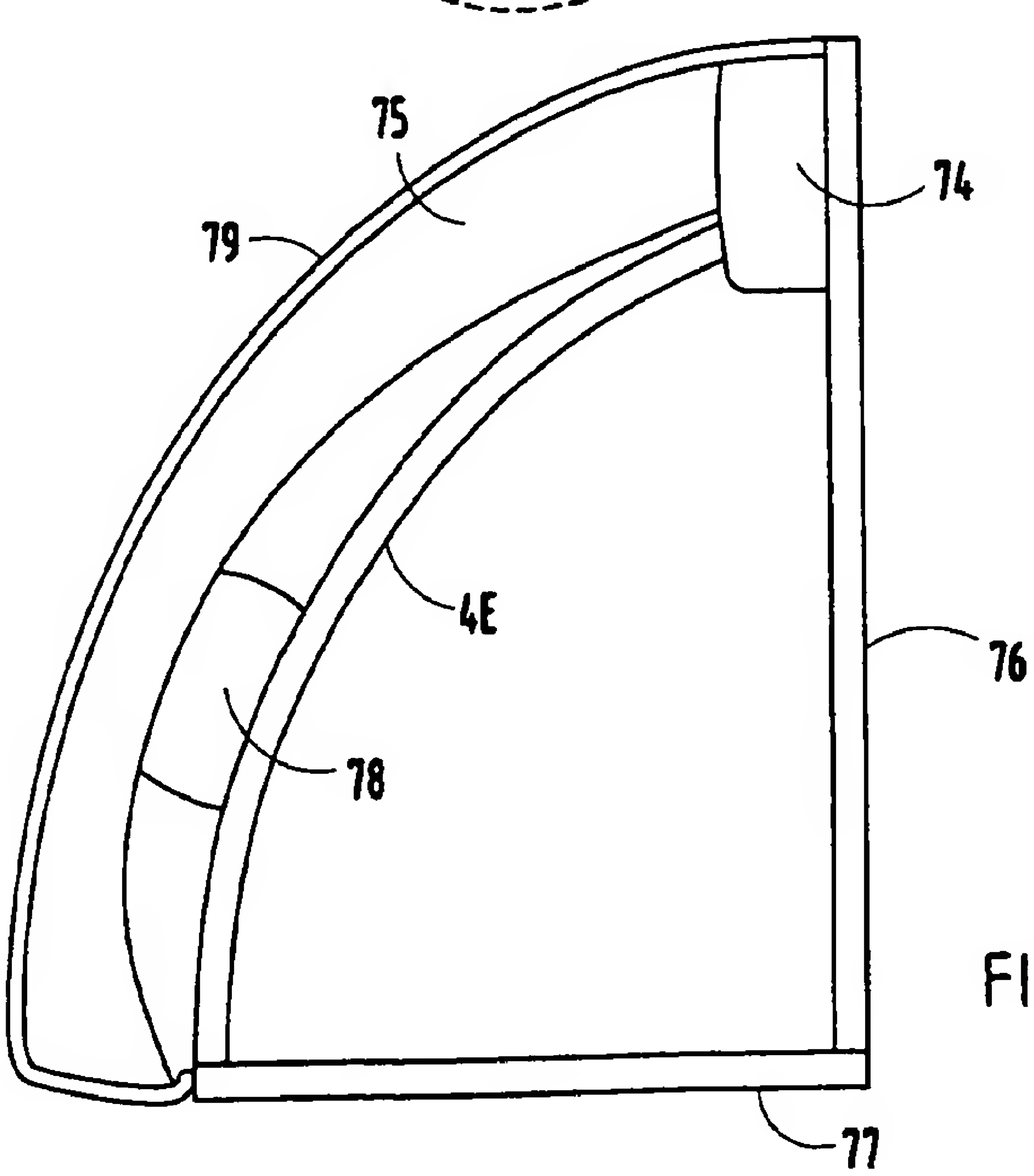

FIG. 14